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GEOLOGICAL SURVEY ——— REPUBLIC OF BOTSWANA

REPORT

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TITLE: TO ASSESS THE VALUE OF SATELLITE PHOTOGRAPHS IN
RESOURCE EVALUATION ON A NATIONAL SCALE
ERTS-1 Type I - 2 REPORT

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"To Assess the Value of Satellite
Photographs in Resource Evaluation
on a National Scale"

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Supplementary Notes: (1) This report was written by S.M. Akehurst
(2) The opinions voiced in this report are not
necessarily those of the Principal
Investigator.

Abstract and discussion of significant results:

Some observations are made on ERTS colour imagery and comparison of imagery.

Results of geophysical work are correlated with ERTS imagery and "new" lineaments are postulated in the northern Kalahari Desert. ERTS imagery reveals complex structural trends in the Basement Complex in the Selebi-Pikwe area.

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**"To Assess the Value of Satellite Photographs
in Resource Evaluation on
a National Scale"**

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ERTS-1 Type I no. 2 report, Botswana.

1. Apologies are made for the late submission of this report.

2. General Observations

2.1 Colour imagery in MSS bands 4,5 and 7 began to arrive late in May and has made an important contribution to the ERTS study. It has revealed features that had either been misinterpreted or could not be detected previously.

For instance, bush fires can be seen on images 1052-07452 and 1052-07463 taken on 13th. September, 1972. The prevailing wind was from the north-east. These bush fires had not been seen before and their track may explain the strange markings on 1052-07463 which were commented on in the first Type I report. The markings, which had been postulated to be possible structural trends, are probably just the traces of small fires.

Towns are immediately visible on ERTS imagery. Vryberg, Mafeking and Lichtenberg in South Africa are clearly seen on 1069-07420 (Vryberg) and 1069-07414 (Mafeking and Lichtenberg) as blue areas surrounded by pink-toned suburbs.

Lobatse is barely visible at the northern edge of 1069-07414 and Francistown can just be made out on image 1069-07402 where it is partially obscured by cloud. Selebi-Pikwe can just be seen as a blue dot on 1122-07353.

The North-South road and railway running through eastern Botswana can also be distinguished, particularly on image 1069-07402 which covers an area where the road and railway are separated for some miles. The road can be picked up as a white line, the railway as a black one.

This gives an indication that long, linear features can be easily discerned even if they are only approximately 10-15 m wide.

The mass of colour imagery of the country gives the impression of natural colour thus revealing the generally poor and sparse nature of Botswana's vegetation. Red patches/^{indicating vigorous growth of vegetation} appear only along river valleys, such as the Limpopo and Motloutse, which may store water near the surface although they are not actually flowing. The only other promising areas seem to be the easternmost 'arm' of Botswana which is north of the Tuli Block, the Okavango Delta and the Linyanti and Chobe channels.

As was deduced from the black and white imagery, the irregular patchiness of the eastern Kalahari reflects old burn patterns and regrowth of vegetation.

2.2 Comparison of ERTS imagery has proceeded as time permits. It has revealed the gradual filling of the Shashe reservoir. Construction of this reservoir and dam in the Shashe river has only recently been completed and the water is to be fed by pipeline to the Selebi-Pikwe copper mine and township.

Image 1122-07353-7, taken on the 22nd. November, 1972, shows that there was no water behind the dam. A month later, on the 29th. December, a small amount of water had collected in the reservoir (image 1159-07410-7) and by the 3rd. February, 1973, (image 1195-07411-7) the reservoir held three quarters of the capacity as at 28th. March, 1973, (image 1248-07355-7). On the 11th. March, (image 1231-07413) the reservoir was almost as full, but not quite, as on the 28th. of that month.

1053-07513-7	14th. September, 1972,	1071-07513-7	2nd. October, 1972
1125-07522-7	25th. November, 1972,	1179-07521-7	18th. January, 1973
	1233-07524-7	13th. March, 1973.	

This imagery was used to compare water flow in the Boteti river over the summer (rainy) season, 1972/73. The Boteti river feeds the Mopipo reservoir built by Anglo-American to serve the Orapa diamond mine and township.

The first image was taken one day before maximum flood occurred in the Okavango Delta from which the Boteti flows. In fact, the second image shows that the river was quite full in its upper reaches. Unfortunately, the lower stretch of river is concealed by cloud. The final image in the series shows that the lower reaches of the Boteti were quite dry at the end of the summer while long pools of water were lying stagnant some miles to the southeast of Maun. Colour image 1052-07461 revealed that the Mopipo Reservoir is either quite shallow or considerably silted up as the colour of the area is turquoise blue.

It is considered that the hazy nature of the first imagery of Botswana taken in September, 1972, is due to the dust in the lower atmosphere raised during the preceding five months corresponding to the dry winter season. Despite the relative lack of rain during the summer, later imagery is much clearer.

2.3 Processing. Ten sample 70 mm negatives in MSS 7 were sent to Log-Etronics, Virginia, U.S.A., for printing. Their black and white products give a most pleasing result where tonal differences (density contrasts) are greatest. This means that areas of water show up most clearly which could be of considerable value in determining surface water in Botswana.

The slight magnification of the prints gives an indication that this, too, maybe an aid to interpretation. Unfortunately, it has been difficult to produce enlargements in Botswana, largely due to the problems encountered with processing of the negatives and work-load at Government Printers. LogEtronics, despite their sophisticated equipment, could only produce prints of minimal density contrast over the majority of the country and which were blurred and very light in tone at the edges.

3. Geological Investigation

3.1 Images 1052-07452, 1178-07460 and 1178-07512 were examined by D.J.V. Pretorius, Senior Scientific Assistant at Geological Survey. He has been engaged on geophysical resistivity surveys in this area in the search for water to supply contractors building the Botswana-Zambia Highway through northeast Botswana.

His work has revealed numerous northeast-southwest trending faults of considerable length and these are verified on the ERTS imagery.

One lineament is reckoned to be the surface expression of the faulted Stormberg basalt and Eccca Series interface which extends into Rhodesia north-west of Wankie under a layer of Kalahari Sand. He and S.M. Akehurst thus agree that prospecting for coal in the Eccca Series would best be confined to the southeast side of this linear feature.

3.2 Image 1126-07580, which was interpreted for the previous Type II report as part of northwest Botswana, was sent as a negative to LogEtronics for processing. The slightly enlarged print received reveals that the outermost margin of the Tautse Flats as interpreted earlier, may in fact be a neo-tectonic feature which strikes north-northwest to link up with the present southwest limit of the Okavango Swamps. It crosses the drainage divide some 32 km southwest of Tsau. The inner margin of the flats can also be seen to extend a further 20 km to the northeast than was shown on the map.

3.3 Image 1179-07521-7. Examination of this image has given rise to supposing that the course of the Boteti river may be controlled by northeast and north-northeast trending lineaments. Certainly, tonal contrasts across these straight features are remarkably consistent. They appear to extend for distances up to 130 km. There is also possibly a northwest trending lineament to the southwest of the image which appears to have been displaced by one of the north-northeast features approximately 4 km.

3.4 Images 1123-07353-7, 1158-07352-7 and 1248-07355-7. Evaluation of structural trends in the Basement is in progress particularly with reference to the Fikwe area where the Madinare "straightening" zone (Hepworth) separates the North Marginal Zone (Mason) from the Central Zone (Mason) of the Limpopo Mobile Belt.

The "straightening" zone appears to be an extension of the easterly striking Letlhakane fault to the west, which fans out just north of the Motloutse river at Pikwe and extends eastwards into Rhodesia at the northern limit of the Karroo basalts.

"Mason (1968, 1969) considered the prominent Letlhakane fault, south of Madingare, to represent a fundamental line of weakness along which dextral trans-current movement took place whilst the Limpopo Mobile Belt was still active. Normal post-Karoo movement, down-throwing to the south, represents the latest reactivation of the fault" (Bennett, 1971)

Intensely folded structural traces are also clearly seen.

3.5 N. Robins, formerly Hydrogeologist at Geological Survey, conducted geophysical resistivity surveys earlier this year over 170 km on the road between Serowe and Letlhakane, an area which is covered by ERTS imagery 1069-07402-7 and 1052-07461. The aim of the programme was to locate faults and dykes as part of a regional geohydrological project.

ERTS imagery revealed a large shear zone and two minor faults confirmed by the geophysics which had not been located previously. None of these features are visible on aerial photographs in an area blanketed by Kalahari Sand.

However, geophysics has uncovered an additional ten small faults and an area which appears to be underlain by igneous rocks. These features could not be seen on ERTS imagery.

Robins points out that by following the shear zone on the ERTS image, an area of groundwater recharge is instantly defined. On the other hand, he is sceptical about the in-depth value of the imagery in the evaluation of concealed features and cautions that detailed geophysics and drilling are still necessary for adequate investigation. His summary of the project will be included in the final ERTS report.

4. Agricultural Investigation

The Department of Agricultural Extension have initiated a land-use classification analysis of Eastern Botswana. A particular project started late last year involved cultivation of land some 20 km south of Kanye and ERTS imagery was scrutinised for any signs of change. The fields were approximately 20 acres in size and the crop was ready for harvesting in March. Unfortunately, no traces of this arable scheme could be located on the black and white imagery and a colour image has been ordered from NASA.

5. Cartographic Investigation

The Department of Surveys and Lands has embarked on a programme of 1:250 000 topographic mapping of the Kalahari which has not been covered by

aerial surveys. No results are yet available.

6. Hydrological Investigation

The principal investigator in this field, B.H. Wilson, is on long leave and has deputed his work to other members of the Department of Water Affairs. No results have been received at this office for the last three months.

7. Ecological Investigation

There has been no progress in this sub-discipline for the last three months.

8. Plans for the final stage of the ERTS-1 Project

The Geological Survey will continue evaluation of lineaments seen on ERTS imagery.

The Department of Surveys and Lands will use ERTS imagery as a control for topographic mapping of remote areas of the Kalahari at a scale of 1:250 000. A team is about to leave to establish ground control.

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